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Just Science: Reflections on Teaching Science at Jesuit Universities

Trileigh Tucker



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Introduction

Several years ago, my university began a search for a new Dean of the School of Science and Engineering, and as part of the process, the search committee developed a set of questions to ask all candidates. Having gotten increasingly interested in justice issues in recent years, I suggested in an e-mail to all science and engineering faculty (about fifty-five) that one of the questions should ask about candidates' interest in justice issues. Two faculty members sent public e-mails in response, both disagreeing with my suggestion. One stated, "I would suspect that science and justice would overlap only rarely, if ever." The other said that "politics," as a matter of individual conscience, should be left out of the dean candidate selection process. No faculty member responded publicly in favor of explicitly discussing justice in the dean search, although several told me privately that they agreed with this suggestion.

Fortunately, our new dean turned out to be a person with a strong commitment to justice, whom we were very excited to welcome as part of our campus community. But the resistance from thoughtful, intelligent faculty both surprised me and motivated me to think more carefully about whether, why, and how justice and college science should be interconnected, particularly at Jesuit universities. (I am considering only

natural science in this essay, not the social sciences nor the technological developments that stem from natural science.)

Interactions Between Science and Justice

Science's role in society

Perhaps the most straightforward role of science in promoting justice in human society is the generation of information that can be used to help remedy injustice. The most basic form of human dependence on nature concerns our absolute physical reliance on it: breathable air, drinkable water, fertile soil. What constitutes a healthy natural environment, and whether all humans have equal access to these essential natural supplies, are justice-related questions on which scientists--biologists, physicists, chemists, earth scientists--can help to shed light.

It has become clear in recent years that there are profound injustices generated by the ways humans interact with the natural environment. One set of injustices is created by intense, localized activities that pres-

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ent significant short-term health threats to less-powerful individuals and groups. For example, scientific and statistical work generated the 1987 landmark study by the Commission for Racial Justice of the United Church of Christ, which documented a clear correlation between siting of toxic waste facilities and locations of marginalized populations across the U.S., independent of community socioeconomic status. Another set of injustices arises from long-term, global changes that may present threats not only to individual human lives, but also to complex living systems that support humans; not only in the present but also in future generations of humans and other creatures who have no say about the damage being done to them. Climate change, almost certainly caused by tremendous fossil-fuel burning and chemical emissions by the industrialized countries, is already causing problems for people in less-developed countries. These problems took a long time to create, and their solutions will also require a long time to take effect, even if implemented today. Future generations will pay much of the cost of consumption by today's developed countries.

Example after example shows that the world's poor suffer the most from environmental degradation, and that it is the world's wealthy who contribute most to environmental damage, in large part through their highly disproportionate consumption of the world's resources (Sachs, 1995). Scientists' work is essential to understand and remedy this situation. Having the ability to generate such useful information, are we scientists morally bound to see that our research is used to help heal injustice, as we understand it? I don't see how *we can avoid this imperative: withholding life-giving information is akin to withholding food that it is within our power to give to starving people.*

A more complex relationship between science and society lies in the infrastructure of the scientific enterprise. Scientific research is a major U.S. industry, funded both by private enterprise and by tax dollars. Although scientific research itself is supposed to be morally neutral, *how* this scientific research interacts with the rest of society raises profound justice questions:

- In what geographic areas is scientific research conducted, and how does this research affect people living in these areas?
- Who ultimately benefits from the research, and who pays the various short- and long-term costs of the research?

- Who funds the research, and why?
- How are decisions made about which of a set of competing proposals will receive funds?
- To what uses will resulting information be put?

A third form of justice-related interaction between science and society lies in the proposal that scientific theories are not always neutral, but can reflect *and promote* cultural biases. Examples are rampant throughout the history of science; for instance, the "scientific finding" that "women's low brain weights and deficient brain structures were analogous to those of the lower races, and their inferior intellectuality explained on this basis" (Haller and Haller, 1974). Science's reputation as a "fact-based," "neutral" enterprise can blind both nonscientists and scientists to its potential biases, which can then perpetuate injustices.

Justice issues within the scientific community

Scientists sometimes unconsciously extend their conviction that *science* is morally neutral to mean that the *scientific community* is outside of justice-related evaluation: "those questions don't apply to our work." A professional whose career is based on her or his demonstrated ability to make objective, unbiased evaluations of scientific observations and theories does not necessarily apply this well-honed skill to applications of junior faculty toward tenure or toward annual reviews of another's performance. And science faculty at universities around the country, like most faculties, are still disproportionately white and male, and hold higher ranks than women and nonwhites, even when comparing *within age groups* (National Science Foundation, 1999). There is little question that racism and sexism are still creating situations of injustice within the scientific community.

Scientists' Concerns about Justice and Science

Personal, not professional

A number of scientists would probably contend that it is fine for a scientist to care about justice and injustice -- on her or his own time, but not in her or his *professional* life. As a professional, a scientist is supposed to be objectively interested in facts, processes, and theories about the natural world (which are communal in nature, agreed upon or argued over by the scientific community), not questions of fairness or

moral rectitude (which are considered private assessments and therefore not appropriate for communal interactions in the workplace; or which do not relate to the nonhuman realm of interest of the professional natural scientist).

These convictions are often derived ultimately from a healthy respect for the impartiality of science. One of the gifts initially brought by modern science to the seventeenth-century world was respect for the individual as a source of true observations. Ideally, anyone who carefully observed or measured a phenomenon would find the same data, independent of who she or he was, and independent of external authorities such as the church or government. In part because of this history, modern scientists tend to be strongly suspicious of "external" ethical or moral frameworks, which they see as potentially constraining their scientific research.

Diminishment of scientific truth

A concern of many thoughtful scientists about bringing justice into the realm of scientific inquiry is that allowing a moral attachment to outcomes may inhibit free investigation and diminish instead of expand the truth of science. Scientists are aware that many opposing conclusions can be promoted from a single data set, by emphasizing particular subsets of those data and by using loaded language in communicating about the data.¹ The observations and statistics are the same for each scientist, but the implications of these numbers may vary according to the conviction of the individual. If a scientist hopes that her or his inves-

¹An example used by theoretical physicist Brian Martin compares two studies published in the prestigious journals *Science* and *Nature*, concerning how exhaust from supersonic jets affects stratospheric ozone. One scientist refers to the "shield" of ozone, the "burden" of NO₂, and the "threat" to ozone. The other refers simply to the "ozone layer," "amounts" of NO₂, and how chemicals "interact with, and thus attenuate" ozone. Each scientist quoted by Martin "emphatically denied they had engaged in 'pushing'" a viewpoint. (Martin, Brian, 1979.) Even if neutral language is used in contrasting studies, one scientist might emphasize (perhaps by consciously or unconsciously allocating more text to) the statistical *probabilities* of a phenomenon, another to the statistical *uncertainties*.

tigations will help heal injustice, is it not possible or even likely, the argument goes, that the scientist will unconsciously bias her or his investigations in favor of a particular set of data that seem to support a justice-promoting conclusion?

Because of the long history of scientific conclusions reflecting societal prejudices (not only prejudices we abhor but those with which we are in alignment), we must admit the reality of this possibility. I believe that reconciliation of this concern lies in a deep conviction about the compatibility of truth and justice; that it is a scientist's--and any human being's--duty to rigorously seek truth, to be continually skeptical about and retest any of one's conclusions, to seek contrasting views from one's colleagues, and to trust that justice need not fear truth, but actually depends fully on it. To seek this truth, we must work hard to understand our own biases so that we can try to release them in the cause of justice.

Inhibition of scientific research

Another authentic concern of scientists has to do with the relationship between scientific research and its potential technological uses. Many scientists fear that others' concern for justice--by others' definitions of justice--will require them to stop their research for fear of its potential technological applications: for instance, developing deadly missiles or cloning "perfect" human beings. Scientists point out that technological outcomes of their research are unknown, and that if research were halted from a fear of negative applications, just as many positive, life-giving ones might be lost as well. It can be easy for even a highly ethical scientist to conclude that she or he is not morally responsible for the unpredictable outcomes of her or his work. How much responsibility a scientist has for either immediate or potential long-term applications of her research is a matter for the individual scientist-but in our current scientific culture, even asking the question is discouraged.

The above objections, and others, are often raised out of a healthy respect for the importance of keeping science distant from the biases of society. But ironically, this distance also allows perpetuation of those biases as scientists stay uninvolved with the societal context of our profession. Even without complete knowledge about how our research might be used, we as scientists can begin to ask challenging ethical questions about our work. We can also hold ourselves open to

nonscientists' questioning the values, assumptions, and ethical bases of our research. Engaging in such reflection and dialogue is squarely in the Jesuit tradition, as we try to help guide our profession toward a greater call for justice in all realms.

Interactions Between Justice and College Science

Why bring justice issues into college science at all?

As a long-time teacher of science courses for non-science majors, I can aver that most of these students initially come into a required science course with trepidation or even resentment. Teaching science through consideration of its relationship to justice issues can open science to these students in a way that they find meaningful and inviting. More importantly, at liberal-arts universities, non-science majors often constitute a much larger proportion of all graduates than science majors--and therefore the majority of college-educated citizens. Their required college science course(s) may be their first, or even only, acquaintance, as adults, with science as a human endeavor and a way of interacting with the natural world. Such a course may therefore be a particularly powerful communicator of values embedded in the practice of science. *All* ways of practicing science express values, whether implicit or explicit--including values about whether science should concern itself with questions of justice.

For science majors, there are additional considerations. All students should be educated not only about *their profession's intellectual content and ways of proceeding*, but also about its interactions with society, including its implications for justice work. These aspects of professional education are occasionally made explicit in graduate school; rarely in college, even though many students will go directly into the scientific work force after graduation. Scientists who have not deeply considered their profession's societal responsibilities are unlikely to be open to non-scientists' judgments on this topic--so who then is to assess whether science is in an appropriate relationship to justice? At Seattle University, approximately 20% of our undergraduates major in science. Do we want one-fifth of our graduates to go out into the broader world believing that their profession need not be concerned with justice?

Ways to raise justice questions in science courses

Science through case studies. I have found that studying concrete situations in which scientific principles are critical to evaluating and resolving an unjust situation is a highly effective way to reach two goals: to get students immediately engaged in trying to understand the science behind the situation, and to help them see connections between science and justice. For example, in my introductory geology class (typically taken by non-majors to satisfy their science requirement), I have used the Green Belt Movement of Kenya, founded by Wangari Maathai in 1977, as a case study. This situation raises justice-related issues such as the role of local ver-

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sus colonial jurisdiction, empowerment of the poor, and the importance of sustainable development that takes into account the needs of future generations. To fully understand the role of the Green Belt movement, students must understand how soil develops, how deforestation affects soil erosion, plate tectonics (to explain why Kenya has no fossil-fuel deposits of its own), and climatology (to understand what constitutes sustainable agriculture for this region). Role plays, with students taking different viewpoints on a justice question, can promote the valuable understanding that scientific information can be used to support *either* side of a debate.

In choosing justice-related case studies, I think it is important to bring in local situations as well as distant

ones. Studying stories from across the world helps students understand their roles as global citizens but can also lead students to believe that injustice happens somewhere else, to "others." Studying stories from our own "back yards" helps science students see that the requirement to work for justice applies everywhere.

Scientists as examples. Using scientists' biographies to help students understand a particular branch of science is valuable because it reminds students of a fact that science courses often neglect: the existence of science requires scientists, human beings who inevitably bring not only our intellects but also our personalities, backgrounds, and biases to our work. Students should learn that science is a human endeavor with the strengths and limitations of all human endeavors: strokes of genius and exquisite beauty, and unconscious biases and value assumptions.

Students also respond strongly to guest speakers, local scientists who work actively to promote justice through their work. I've also found that their talking with my class can be an affirming experience for the scientists as well, since they often feel they may not discuss their justice-related work with their professional colleagues.

Student research, service learning, and internships. Another highly effective way to help students connect justice and college science is for them to conduct their own research and field work in this area. Their work may involve only library research; but more effective is hands-on learning in which students also interview people who have been involved with situations of injustice, or in which they perform scientific research themselves to make a real contribution to remedying injustice.

Many of our Ecological Studies majors have worked in the South Park area of Seattle. Most of the area is zoned for heavy industry and is characterized by a largely nonwhite residential population and a median household income below Seattle's average. Along with numerous sites hosting toxic chemicals, South Park area contains two Superfund sites. Several Seattle University students have completed internships with people working to clean up toxics in the neighborhood. Some have collaborated with the Community Coalition for Environmental Justice, analyzing land-use and population data for South Park. Others have used phytoremediation techniques to help clean a creek feeding the nearby Duwamish River. In these projects, students

come to understand stream dynamics, toxicology, groundwater chemistry, fish biology, and soil development. They also become passionate about their work and consider their project supervisors to be "eco-heroes" who are true role models for authentic living.

Modeling justice in the classroom. One of the most dangerous ideas about college education, in my opinion, is that it is not "the real world." The idea that the way we interact in college "doesn't really count" means that students can leave our universities without experiencing a mutually accountable community. We talk in the classroom about working for justice--but the classroom community itself is often an absolutely centralized power structure. In the classroom as well as every other venue of societal life, an authority's hidden (or sometimes explicit) biases and prejudices can thwart the call to live in right relationship. Because students who have been accepted to a college typically performed well in similar pre-college educational systems, they tend to accept and promote this power structure, along with many of an authority's biases.

Many of the authority relationships manifested in the classroom are appropriate and effective ways to promote true learning. But I am continually astounded at how easy it is to fall into other authority patterns that are less healthy, in which I fail to respect or learn from my students' insights and wisdom. Even with attentiveness, any of us can unintentionally promote prejudices that inhibit the creation of a just community in our classes. For example, a few years ago I was preparing to give a talk at a national science conference, and I chose some slides of students doing geology class exercises. In one of my preliminary run-throughs, I (fortunately) noticed that in every slide, a male student was performing the action, and female students were looking on. Was this a matter of which slides I chose? Which classroom scenes I decided to capture on film? Or did this gender imbalance characterize my class as a whole, and had I simply captured an accurate picture of what happens on a regular basis? If so, was there something I was unknowingly doing to perpetuate or even increase that imbalance? If I had happened not to notice the pattern in my slides, I could have perpetuated through my presentation the bias that men are most actively engaged in science, and that women are more passive, less interested. Of course, the same violation of justice is manifested in the often-reported tendency of teachers to call prefer-

entially on male students or white students for active class participation. (Hess, 1995). We must be always vigilant for our own prejudiced thoughts and actions. As teachers interested in justice, we can share our authority by explicitly inviting class discussions on topics such as power structures in the classroom; gender and science; race and science. We can also model a concern for justice by expanding our realm of care beyond the micro-community of our classroom; we can consider together with our students what information or education we as a class could offer to help remedy a specific situation in which justice has been violated.

Some proposals for college science

1. **No student should graduate from college with a science degree without having taken at least one course that deals with issues of justice and science.** This is not to say that all science courses must raise these issues. But we are not preparing our students to be contributing world citizens unless they reflect on the role of their profession in society and in promoting a more just world.

2. **In a college's offerings of science courses for nonmajors, at least a few courses should raise questions about the relationships between science and justice.**

3. **Science faculty should take professional time to reflect on questions of how their work interfaces with justice.** Such reflection could be part of an annual faculty retreat, informal lunches hosted by

the dean, a lecture/discussion series, or other forms appropriate to the university.

Summary

One of the charisms of Ignatian spirituality is that it is world-affirming, believing that "God can be discovered, through faith, in all natural and human events." If our Jesuit education is to be world-affirming, we must be attentive to the discoveries of natural science. If our Jesuit education is to be communal and companionate, we must engage in a dialogue with scientific culture. And if our Jesuit education is to flow from the "faith that does justice," we must reflect deeply, and then act, on the profound interrelationships between science and justice in human societies.

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